EXPERIMENTAL INVESTIGATION OF HEAT TRANSFER TO A METALLIC ROD IN A FLUIDIZED BED OF SMALL PARTICLES

M.S. Hatamipour, D. Mowla
Chem. Eng. Dept., Isfahan Univ., Isfahan, Iran
hatami@shirazu.ac.ir

Abstract
The effect of heat carriers on heat transfer to a cylindrical metal bar was investigated in a pilot scale fluidized bed with small spherical solids (2.7 mm glass beads and steel balls). Rods of aluminum and steel, each with 10 and 20 mm diameter and 60 mm length, were heated by means of hot air. In each experiment the temperature of the center of solid was measured at various intervals of time. The effect of various parameters such as air velocity, air temperature, mass ratio of fluidizing material to solid, type of fluidizing material, diameter of fluidizing material and diameter of solid were investigated.

It was found that presence of small spherical fluidizing solids enhances the rate of heat transfer. The rate of heat transfer increases with decreasing solid diameter, increasing the fluidizing material thermal conductivity, and increasing air temperature, but air velocity and amount of fluidizing material have no significant effects on the rate of heat transfer in well-fluidized systems.

Key words: Fluidization, Heat carrier, Heat transfer coefficient

1- INTRODUCTION
Recent concern for more efficient use of the world’s available energy resources has led the researchers in the field of drying to use novel techniques for enhancing heat transfer coefficient. Improving the rate of heat transfer can provide significant benefits to the drying process. Fluidized bed drying is a technology of growing interest in industry, with applications that range from processing of solids to pastes and slurries.

Cobbinah et al. (1987) investigated simultaneous heat and mass transfer between a fluidized bed of fine particles and immersed coarse porous particles, and correlated total heat transfer coefficient with transport and physical properties of the fluidizing medium.

Bak et al. (1989) investigated the heat transfer characteristics of a vertical tube in a fluidized bed combustor and developed correlations for convective heat transfer coefficient. Hatamipour and Mowla (2003) investigated the effect of heat carriers on the rate of drying of cylindrical particle of carrot. They performed a comparison between drying rate with and without heat carriers in a fluidized bed dryer, and found that the drying rate with heat carriers was significantly higher than that without it, which indicates that heat transfer is significantly increased by the existence of heat carriers. They also developed a mathematical model, which is suitable for engineering calculations. Mickley and Fairbanks (1955) determined the mechanism of heat transfer to fluidized beds and concluded that the process controlling fluidized heat transfer may be considered to be an unsteady state diffusion of heat into mobile elements of quiescent bed material. Holman (1981) gives the finding of some authors on heat transfer characteristics of a cylindrical body in cross flow. This article reports on a comparative investigation of heat